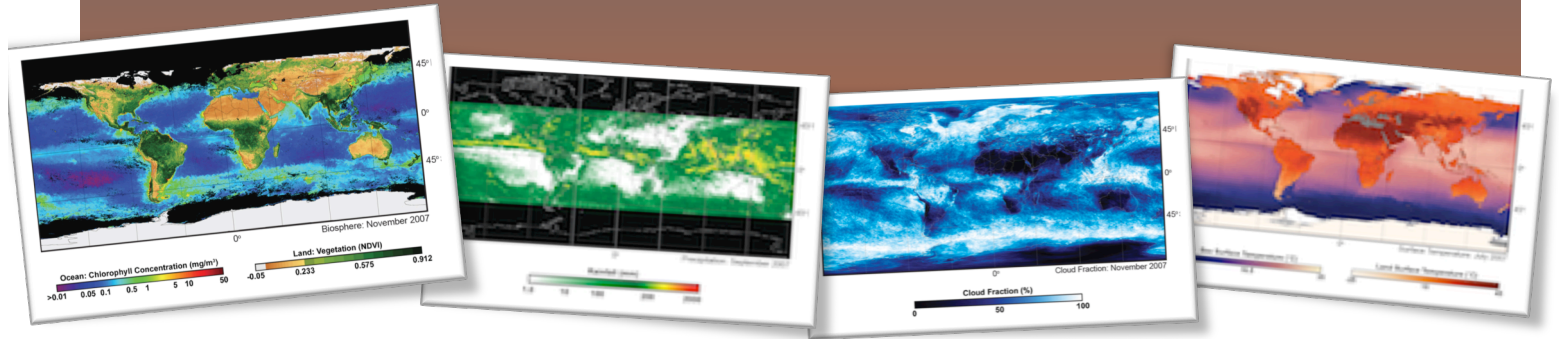


MY NASA DATA- GLOBE Digital Earth System Poster

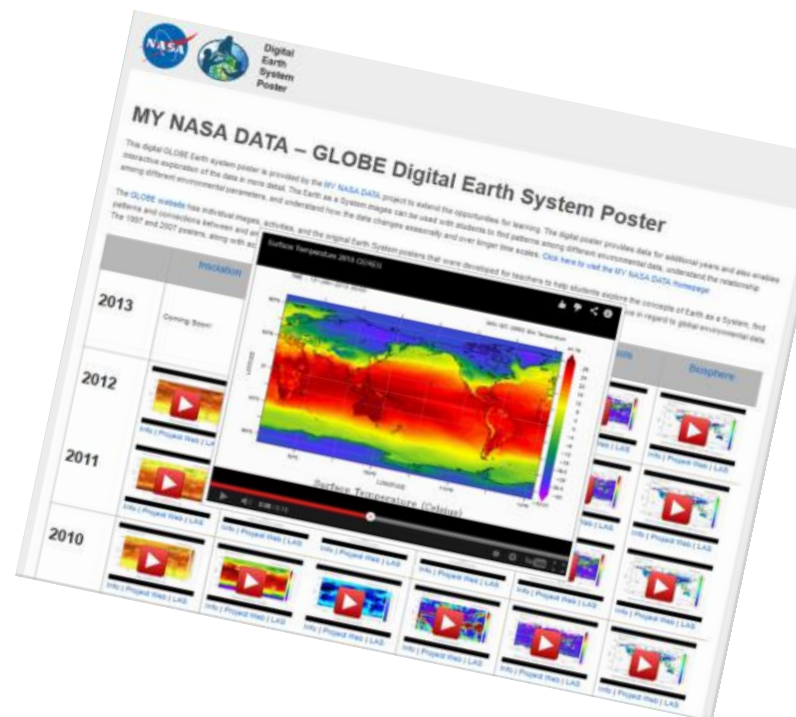
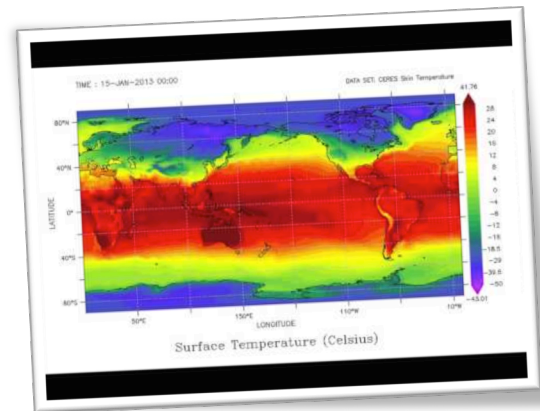
<http://mynasadata.larc.nasa.gov/globe/>

Implementing the NGSS Grades 9-12

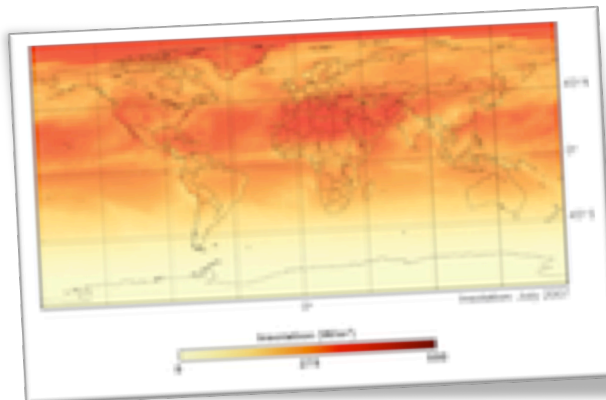


In the Classroom:

The GLOBE Digital Earth System Poster was designed to provide teachers and students an opportunity to explore data and provide them with the ability to identify relationships between/among the different components of the Earth system. It allows students to visualize how the different variables change throughout the course of a year, make comparisons between years to establish cause/effect relationships for a specific variable, identify patterns and determine relationships between variables. It can be used as a tool to implement the NGSS Science Practices, Disciplinary Core Ideas, and Crosscutting Concepts as they relate to the performance expectations. Activities ideas are provided for each of the identified performance expectations.



Additional Lesson Plans: <http://mynasadata.larc.nasa.gov/lesson-plans/lesson-plans-hs-educators/>

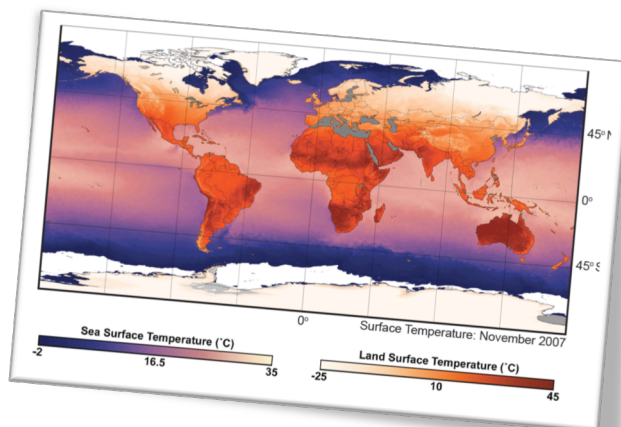


HS-ESS2-2 Analyze geoscience data to make the claim that one change to Earth's surface can create feedback that cause changes in other Earth systems.

Have students work in small groups, in pairs or individually to examine animations for each of the six variables (insolation, surface temperature, cloud fraction, precipitation, aerosols, and biosphere) to identify any patterns they see occurring. Have them identify cause/effect relationships based on the data contained in the animations to use as evidence to support their predictions. They should then compare their findings across different years to determine if their predictions are still supported.

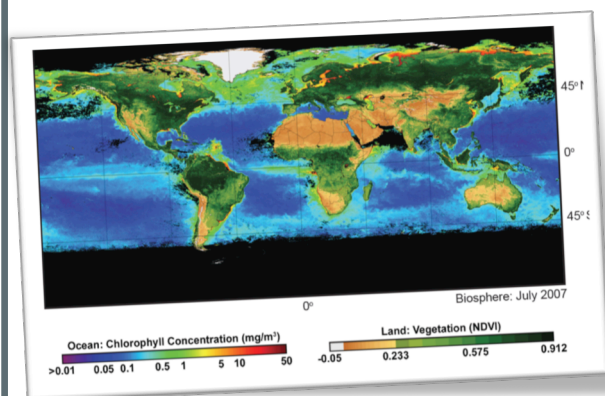
HS-ESS2-4 Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.

Have students examine the surface temperature and insolation animations across different years and compare those to those of the biosphere. What types of relationships do they observe between the variations in energy flow into and out of Earth's system and that of changes to climate across different regions? What types of cause/effect relationships appear to exist between the flow of energy and climate?



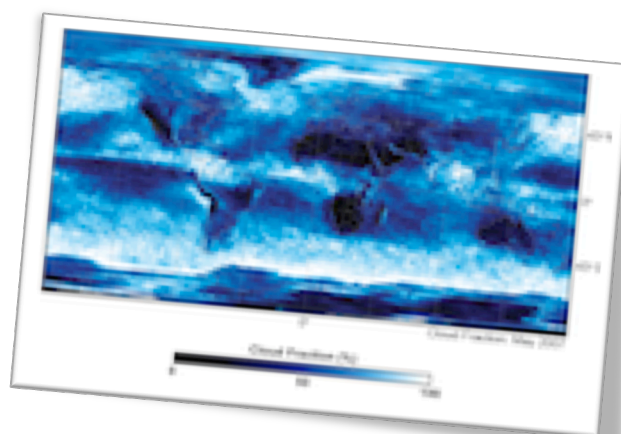
HS-ESS3-5 Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems.

Have students work in teams to examine the surface temperature animations for the years 2005-2013. Instruct them to gather data related to the changes that are occurring in temperature and display it in a graphical representation. Using the data they have collected, they should compare it to the changes they see occurring in the biosphere animations. Ask students the following question: Based on the fact that the animations only contain nine years of data what other data would increase the validity of their predictions? Have them develop an evidence-based prediction for what they expect to happen to the rate of global climate change in the future based on the data they have available.



HS-ESS3-6 Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.

Examine the animations for insolation, surface temperature, cloud fraction, precipitation, aerosols and biosphere. Based on the changes students identify in the data, have them develop a prediction related to the impact of human activity as evidenced by increases in aerosol and surface temperature as they relate to the changes that are occurring in Earth's climate. From these predictions have them develop a computational representation that illustrates their findings.



9-12 NGSS Performance Expectations Using the GLOBE Interactive Poster:

HS-ESS2-2	Analyze geoscience data to make the claim that one change to Earth's surface can create feedback that cause changes to other Earth systems.
HS-ESS2-4	Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.
HS-ESS3-5	Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems.
HS-ESS3-6	Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models <ul style="list-style-type: none"> Use a model to provide mechanistic accounts of phenomena. (HS-ESS2-4) Analyzing and Interpreting Data <ul style="list-style-type: none"> Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. (HS-ESS2-2) Analyze data using computational models in order to make valid and reliable scientific claims. (HS-ESS3-5) Using Mathematics and Computational Thinking <ul style="list-style-type: none"> Use a computational representation of phenomena or design solutions to describe and/or support claims and/or explanations. (HS-ESS3-6) Scientific Knowledge is Based on Empirical Evidence <ul style="list-style-type: none"> Science arguments are strengthened by multiple lines of evidence supporting a single explanation. (HS-ESS2-4) (HS-ESS3-5) Science knowledge is based on empirical evidence. (HS-ESS3-5) Scientific Investigations Use a Variety of Methods <ul style="list-style-type: none"> Science investigations use diverse methods and do not always use the same set of procedures to obtain data. (HS-ESS3-5) New technologies advance scientific knowledge. (HS-ESS3-5) 	ESS1.B: Earth and the Solar System <ul style="list-style-type: none"> Cyclical changes in the shape of Earth's orbit around the sun, together with changes in the tilt of the planet's axis of rotation, both occurring over hundreds of thousands of years, have altered the intensity and distribution of sunlight falling on the earth. These phenomena cause a cycle of ice ages and other gradual climate changes. (HS-ESS2-4) ESS2.A: Earth Materials and Systems <ul style="list-style-type: none"> Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes. (HS-ESS2-1),(HS-ESS2-2) The geological record shows that changes to global and regional climate can be caused by interactions among changes in the sun's energy output or Earth's orbit, tectonic events, ocean circulation, volcanic activity, glaciers, vegetation, and human activities. These changes can occur on a variety of time scales from sudden (e.g., volcanic ash clouds) to intermediate (ice ages) to very long-term tectonic cycles. (HS-ESS2-4) ESS2.D: Weather and Climate <ul style="list-style-type: none"> The foundation for Earth's global climate systems is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy's re-radiation into space. (HS-ESS2-2)(HS-ESS2-4) Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate. (HS-ESS2-6),(HS-ESS2-4) Current models predict that although future regional climate changes will be complex and varied, average global temperature will continue to rise. The outcomes predicted by global climate models strongly depend on the amounts of human-generated greenhouse gases added to the atmosphere each year and by the ways in which these gases are absorbed by the ocean and biosphere. (HS-ESS3-6) ESS3.D: Global Climate Change <ul style="list-style-type: none"> Though the magnitudes of human impacts are greater than they have ever been, so too are human abilities to model, predict, and manage current and future impacts. (HS-ESS3-5) Through computer simulations and other studies, important discoveries are still being made about how the ocean, the atmosphere, and the biosphere interact and are modified in response to human activities. (HS-ESS3-6) 	Cause and Effect <ul style="list-style-type: none"> Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-ESS2-4) Stability and Change <ul style="list-style-type: none"> Feedback (negative or positive) can stabilize or destabilize a system. (HS-ESS2-2) Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible. (HS-ESS3-5) Connections to Engineering Technology and Applications of Science <p>Influence of Engineering, Technology, and Science on Society and the Natural World</p> <ul style="list-style-type: none"> New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology. (HS-ESS2-2)